

## Section 02. Geotechnical Systems Stability

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### **Surveying Control of the Support Condition in Shafts on Mine. the Technologies of a Recovery of the Silo Liner with Anchors**

Modern silo shafts are exploited in a variety of mining and hydro geological conditions, which have a significant impact on the stability of the shaft and, as a consequence, on the condition of its support and reinforcement. Taking into account their constant increase in depth, they are complex objects in terms of their operation and maintenance in the passport condition. A feature of silo shafts is a large number of crossed rock layers, which often differ significantly in their physico-mechanical and strength characteristics. High level of failures is accompanied by cutter breaks, breakouts, deviations from the design position of the reinforcement, which, in turn, disrupts the work of the lifting complex. A set of measures for mine shafts reinforcement, as well as for breaking of their deformations was compiled by surveyors of several mines. In practice, the complex was used at the mine, named after Stashkov.

Mine surveyors of the Stashkov mine conducted instrumental observations of the deformations since their appearance in 2004. In 2010, repairs were carried out by replacing the rigid reinforcement with anchor reinforcement. After exhausting the reserves for increasing the load-bearing capacity of the support by controlling the strength of the concrete, and also if it is necessary to perceive a part of the loads that are developing through time and caused by deformation and creep of the rocks, in 2010, as an additional solution to strengthen the support, a contact-type anchor was installed through the previously elevated support. To ensure a reliable connection of the anchor-concrete-rock system, anchoring of the anchor rod was carried out along the entire length of the hole. Cement-sand mixture was used as cementitious material. In some cases, when there was a necessity of inserting anchors to the work quickly, cartridges with fast-setting polymeric material were used. In order to test the effectiveness of hardening of a monolithic concrete support with anchors of the described construction, mathematical modeling of the operation of the combined support in different conditions was carried out. The data obtained as a result of the calculations showed that the anchor hardening changes the distribution of the normal tangential stresses in the concrete support significantly. If there is an increase in stresses from the outer layers to the inner layers in the support without anchors, then when it is strengthened with anchors, the stresses along the section of the support are equalized. Proceeding from the results of the work, which was carried out, at this stage of development of the Ukrainian coal industry, the topic of developing progressive cost-effective technologies for repairing reinforcements, which are reducing the duration, labor costs and providing increase of safety of work, is topical.